REMARKS/ARGUMENTS

Claim 1 is the only claim pending in this application. Reconsideration of the subject patent application and allowance of the claim is respectfully requested in view of the following remarks.

The Examiner objected to the specification as the meaning of "fm" and "EC" are not clear. "fm" is a typographical error of "μm" and "EC" is a typographical error of "°C" as supported by the parent application 10/097,975. Applicants amended the specification to correct those errors, and request the Examiner to withdraw the objection to "fm" and "EC" in the specification.

The Examiner rejected claim 1 under 35 U.S.C. §112, the second paragraph as "EC" is indefinite. "EC" is a typographical error of "°C" and applicants amended claim 1 to correct those errors. In light of the amendment, the Examiner is respectfully requested to withdraw the rejection.

The Examiner rejected claim 1 under 35 U.S.C. §103(a) as being obvious over Finnemore et al. (6,514,557 B2). The Examiner acknowledged Finnemore et al. fails to teach the substrate being monocrystalline strontium titanate, but took the position that one skilled in the art at the time the invention was made would have had a reasonable expectation of achieving similar results regardless of whether the substrate was monocrystalline or not. The Examiner then invited to supply a showing of unexpected results regarding the criticality of the crystalline state of the substrate.

Applicants believe that the critical current density (Jc) of the MgB2 thin film is greatly influenced by the crystalline state of the substrate. Crystalline growth of the MgB2 thin films depends on the crystalline state of the substrate. An MgB2 thin film formed on a monocrystalline substrate has a c-axis oriented crystal structure. On the other hand, an MgB2 thin film formed on a non-monocrystalline substrate has a disordered crystalline orientation and forms a polycrystalline structure.

The critical current density (Jc) of the MgB2 superconductor of Finnemore et al. is approximately 0.4 MA/cm2 (see the value at zero magnetic field of line 404 in Fig. 8 of Finnemore et al.; a marked copy of Fig. 8 is attached). On the other hand, the critical current density (Jc) of the MgB2 film of the present invention is approximately 20 MA/cm2 (see Figure 4 of W.N. Kang et al., Physical C, pp24-30 (2003), which was filed with the Declaration of June 23, 2004; a marked copy of Figure 4 is also attached). The critical current density (Jc) of the MgB2 film of the invention is approximately 50 times of that of Finnemore et al., and applicants submit that this unexpected result distinguishes the current invention from Finnemore et al.

In light of the foregoing amendments and remarks, applicants submit that the present application is now in condition for allowance. Reconsideration and favorable action are earnestly requested.

Respectfully submitted,

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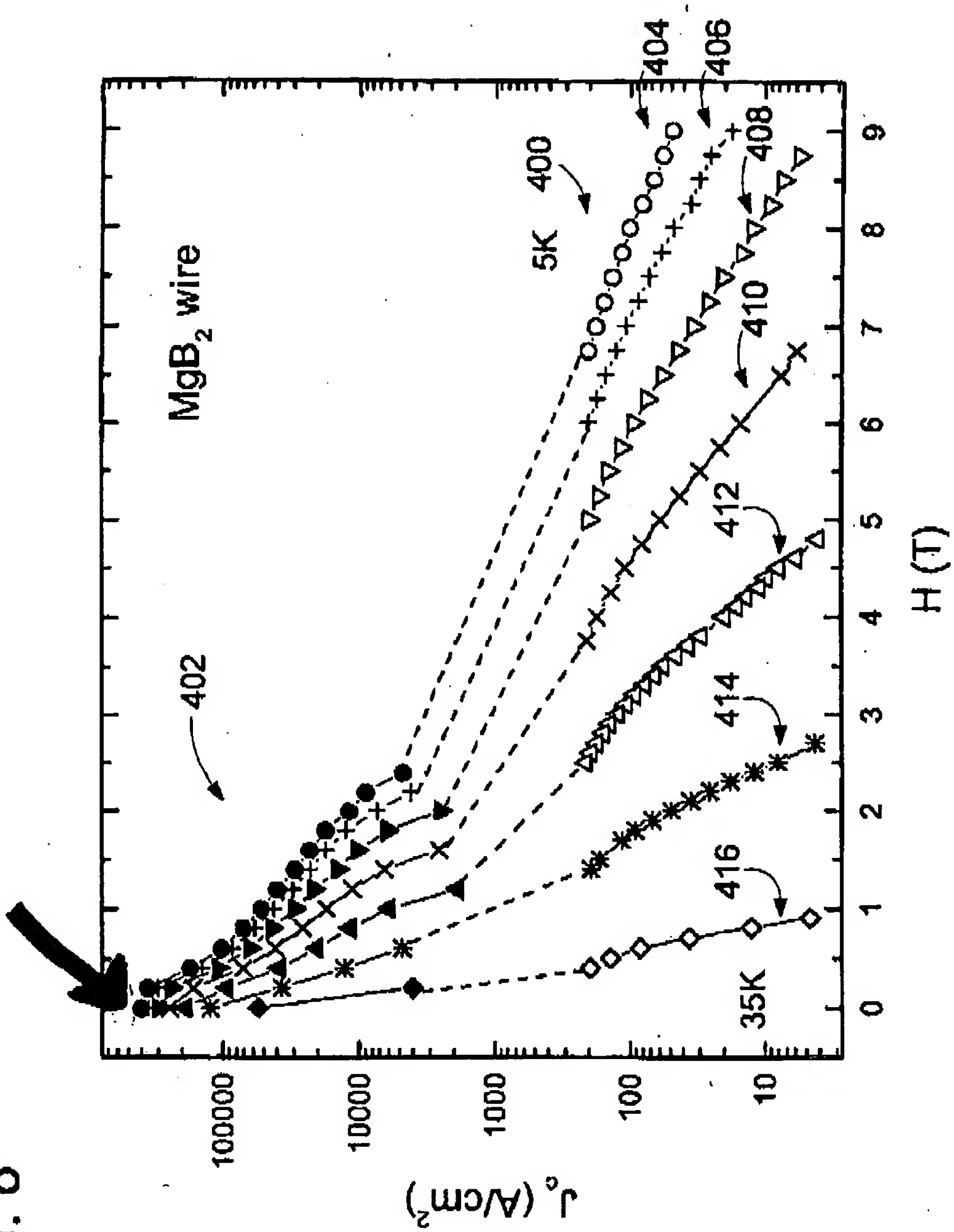

FIG. 8

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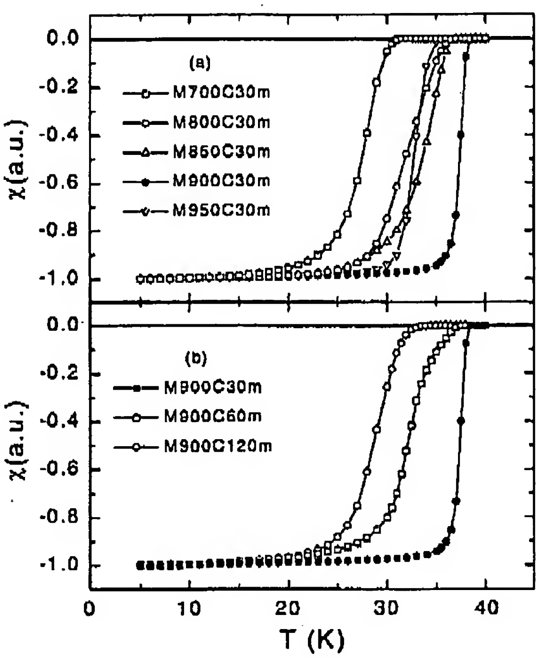

Fig. 3. Temperature dependence of zero-field-cooled magnetization data at 10 Oe for the films fabricated at (a) 700–950 °C for 30 min and (b) 900 °C for 30–120 min.

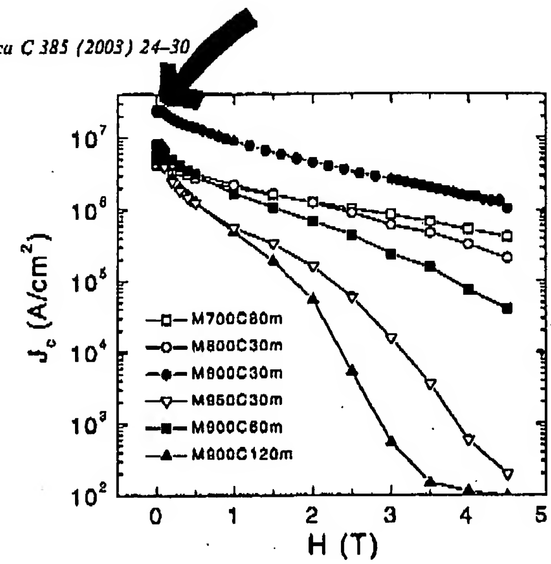

Fig. 4. Magnetic field dependence of J_c at 5 K for various films grown at 700–950 °C for 30 min and at 900 °C for 30–120 min.

good sample for studying physical properties. However, M900C30m better satisfies the requirements for practical applications because of its higher T_c and J_c (see Fig. 4). Using M950C30m, indeed, decisive experimental result was obtained by Iavarone et al. [2], confirming the two-gap nature of the MgB_2 superconductor. In Fig. 3(b), the samples annealed for 60–120 min show a lower T_c and a broad superconducting transition, indicating that longer annealing degrades superconductivity by changing the growth orientation of MgB_2 grains, as shown in the SEM images.

Fig. 4 shows the magnetic field dependence of J_c at 5 K for M700C30m, M800C30m, M900C30m, M950C30m, M900C60m, and M900C120m. To estimate the critical current density, we measured the magnetic field dependence of magnetization (M–H) loop. The sample size, $5 \times 3 - 4$ mm^2, rather than the grain size, was used to evaluate J_c by using Bean's model [33]. M900C30m had the highest J_c of all the samples, 2.5×10^7 A/cm^2 at 5 K in zero field, which is comparable to the values in previous reports on MgB_2 films [7,19,32] and on high-T_c cuprates [34,35]. A J_c of $\sim 10^6$ A/cm^2 at 4.5 T is sufficiently high for practical applications of high-field superconducting magnet systems. This result reflects that the grains of M900C30m are connected very strongly with a high density of pinning sites, such as stacking faults, dislocations, and grain boundaries. At zero field, the J_c values for the other films are $\sim 6 \times 10^6$ A/cm^2 at zero field, but the magnetic field dependence of J_c shows quite different behavior. The samples annealed at equal or below 900 °C and for shorter time (30 min), show weak-field dependence compared to the samples of M950C30m and M900C120m. As shown in the SEM image (Fig. 1(f)), M900C120m has a polycrystalline structure; thus, the J_c depends strongly on the magnetic field as with polycrystalline Fe-clad MgB_2 wires [13]. Different from M900C120m, however, M950C30m shows a very dense surface morphology highly oriented along the c-axis as shown in Fig. 1(d). In the case of this film, the strong-field dependence of J_c probably implies that this sample contains fewer pinning sites than M900C30m (Fig. 1(c)). Our J_c data further support the fabrication process for M900C30m sample being the optimal condition for large-scale applications. For electronic-device